

## Statement of Work

### Background

Nanotechnology, defined as making and manipulating extremely small (<100 nanometers) particles to manufacture new materials and devices, is often likened to the new industrial revolution of today. Although not much is known, these tiny particles may behave much differently than bulk samples of the same material, resulting in unique electrical, optical, chemical, and biological properties. The potential for new products leading to improvements in our lives is astounding. On the other hand, the potential hazard, if any, to workers exposed to engineered nanoparticles is not well understood.

Aerosol science suggests that nano sized particles will quickly agglomerate to larger sizes, or will quickly disperse and deposit on available surfaces. Such behavior makes it easier to control them using established ventilation and filtration approaches. However, the desired characteristic of engineered nanoparticles often depends on them remaining as separate particles. Research is devising methods to prevent engineered nanoparticles from agglomerating.<sup>i, ii</sup> In those cases, engineered nanoparticles may exist as separate particles of only a few nanometers in size.

Personal protective equipment is often the last measure utilized to help reduce exposures against potentially harmful contaminants in the workplace. In the case of particulate respirators, the single fiber theory of filtration supports the assertion that respirators tested using 0.3  $\mu\text{m}$  (300 nm) can effectively filter nanosized particles. The theory predicts that as particle size decreases from 300 nm, diffusion becomes increasingly effective in capturing the particles on the filter fibers. However, a recent study<sup>iii</sup> has suggested that as particles reach sizes of a few nanometers, capture efficiency begins to decline.

### Goals

Therefore, the goals of this study are to determine:

- if single fiber filtration theory is valid for engineered nanoparticles,
- the possible boundaries of the most penetrating particle size range,
- the filtration boundaries of nanosized particles in the diffusional capture mechanism range.

### Benefits

Attaining the goals listed above will accomplish the following:

- Clarify, experimentally, the behavior of filter media for engineered nanoparticles. Such information may extend single fiber theory beyond the traditionally described particle range.
- Understand that if diffusive collection effectiveness begins to decrease, at what particle size this occurs.
- Help identify further research needs.
- Allow NIOSH to make recommendations regarding the effectiveness of respirator filter media for engineered nanoparticles based on experimental data.

### Tasks

Select filter media consistent with that found in NIOSH certified N95 and P100 filter respirators.

- Generate particles over the size range 1 to 300 nm. Several different generation techniques may be used to generate nanometer size particles, such as NaCl and DOP aerosols using a Collison atomizer, and  $\text{TiO}_2$  and soot aerosols using a burner as surrogates for engineered nanoparticles. Particle count and size will be measured using a Scanning Mobility Particle Sizer (SMPS) together with a condensation particle counter (CPC).
- Determine the collection efficiency of the filter media as a function of particle size at several face velocities.
- Include results in a report, coauthored with NIOSH scientists.

Duration: 12 months from award

Deliverables: Test data and a report coauthored with NIOSH scientists.